



**PEDV Brings Its Worst.
Pork Checkoff Brings Its Best.**

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Practical PEDV Information

In this booklet, *PEDV Resources*, you'll find some practical steps created by working groups of industry experts designed to help you reduce the risk posed by PEDV to your pigs. Whether it's enhancing your biosecurity protocols or rethinking the relationship with your veterinarian, there are plenty of good tips and reminders in this booklet, which is often updated and expanded online in English and Spanish at www.pork.org/pedv.



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Porcine Epidemic Diarrhea Virus (PEDV) – What Is It?

Background:

- PEDV is caused by a virus (Coronavirus) that is related to transmissible gastroenteritis (TGE) virus.
- PEDV only infects pigs (NOT humans or other livestock).
- PEDV was first confirmed in the U.S. on May 17, 2013.

Clinical signs: In previously naive herds, PEDV is similar to TGE and includes:

- » Severe diarrhea in pigs of all ages
- » Vomiting
- » High mortality - almost 100% in preweaned pigs

Diagnosis: Requires sample submissions to a diagnostic laboratory (contact your veterinarian).

Transmission: Oral contact with contaminated feces. The most common materials or items that can be contaminated by feces from infected pigs include trucks, boots, clothing, feed and feed trucks or other fomites.

Incubation period: (*time from exposure to clinical signs*) 12-24 hours

Shedding: (*amount of time animals can infect others*) Up to 3 to 4 weeks

Immunity/Protection:

- No cross-protection with between TGE and PEDV even though both are Coronaviruses.
- Maternal protection through colostrum from previously exposed sows can be quite effective.
- Sow immunity after infection appears to last at least 6-7 months. More research is needed in this area.
- Vaccines for PEDV are currently available to help boost sow immunity.

Treatment: Supportive care through hydration. Provide clean, dry, draft-free environment with access to high-quality drinking water (electrolytes may be beneficial).

Prevention: Limit cross contamination with any suspected pigs's feces.

- Clearly define and communicate a Line of Separation which marks the separation between your facility, transport vehicles or the outside / inside of your production site.
- Contact your veterinarian and enhance biosecurity procedures.
- Sanitation of barns, equipment and transportation vehicles is very important; they should be clean, disinfected and dried.
- Several disinfectants have been demonstrated to effectively inactivate PEDV, such as glutaraldehyde/ quaternary ammonium, accelerated hydrogen peroxide, formalin, sodium carbonate, lipid solvents, and strong iodophors in phosphoric acid.
- Replacement breeding stock should originate from a negative herd.

Challenges to Industry: Infection with PEDV can create tremendous financial losses to a pork producer.

Diseases like to “Hitch a Ride,” so separate yourself from cross contamination. Control the accidental spread of disease!

The organisms that cause disease in pigs (bacteria, viruses and parasites) can survive in different types of materials. Organic matter (shavings, manure), feed, water, mud and snow can all carry diseases. Contaminated boots, clothing, tires, undercarriages, trailers, shovels, winter panels, sorting panels and people's clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or packing plant, can increase risk for disease spread because boots and trailers can become contaminated with diseases the farms you serve are trying to keep out. Assume every site you touch is a risk. Do not be responsible for transferring this disease.

For more information on biosecurity and PEDV: visit pork.org or contact a veterinarian.

Guidelines for Diagnosis of PEDV

Key Points

The introduction of the porcine epidemic diarrhea virus (PEDV) into the United States has greatly increased the risk of spreading disease for pig producers.

- When sow farms are first infected, all ages of pigs develop diarrhea, but suckling pigs (< 7 days of age) will have the highest rate of death loss.
- The severity of piglet diarrhea will usually decrease over time in infected sow farms.
- After weaning, diarrhea from PEDV can be severe or mild—like other diseases.

Accurate diagnosis through proper testing is essential to know a herd's infection status.

- PEDV cannot be contained without knowing where the virus is present.
- Knowing the infection status of herds or sites will help the industry better manage our biosecurity practices and control protocols.

Contact your herd veterinarian if you suspect PEDV.

Guidelines for sow herds

Do piglets or sows have diarrhea?

YES → PEDV is a differential

Sow herd: collect feces from piglets or sows acutely affected with diarrhea

Minimum: PCR on 3 pools of feces: Each fecal pool composed of feces from 5 diarrheic pigs from different litters or locations.

Optional: Submit live pigs or pig tissues, along with pools of feces to a laboratory

NO or not much looseness → PEDV may be harder to detect

Sow herd: collect feces from any pigs with diarrhea and older piglets with soft feces

Minimum: 3 pools of feces: Each fecal pool composed of feces from the 5 most diarrheic pigs from different litters in farrowing rooms

Optional: Serum from at least 10 dams (highly recommended) and/or submit live pigs or pig tissues, along with pools of feces and serum

Guidelines for weaned (nursery, grower, finisher) pigs

Do pigs have diarrhea?

YES → PEDV is a differential

Nursery / Grower / Finisher

Oral fluids and feces: At least 2 oral fluid samples AND 3 pools of 5 loose/diarrheic feces each

Optional: Submit representative pigs or pig tissues to a diagnostic laboratory

NO or not much → PEDV may be endemic/chronic or harder to detect

Nursery / Grower / Finisher

Oral fluids and feces: At least 2 oral fluid samples AND 3 pools of 5 feces from five of the most diarrheic pigs in the barn

Optional: Serum from 10-15 pigs for serology (highly recommended)



Positive Diagnosis of PEDV in a Breeding Herd: What Next?

*Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer. PEDV transfers via feces and survives in manure for extended periods of time. Anything that is contaminated with pig manure can be a source of infection for pigs. **There are a number of important actions to take once the diagnosis of PEDV has been confirmed on your site.***

Good neighbor policy, **COMMUNICATE**

Farm/Production System

- At the production level, review all biosecurity protocols for potential enhancement. In a production system, it's proper to notify the main office so that biosecurity protocols can be reviewed.
- If applicable, make sure all supervisors are notified immediately.

Semen Delivery

- Contact the boar stud to make sure the route of semen delivery to the site is not compromising biosecurity.
 - » It is best to have a designated drop box location and avoid having the semen delivery person going to the infected farm premise.

Neighbors

- Contact your neighbors that have pigs in your area. Tell them that you have had a positive diagnosis and that you are working to control the infection on your site.
 - » As a general rule, notify farms located within one to two miles of your site.

Feedmill

- Contact the feedmill if you are purchasing feed.
 - » Let them know that your herd is positive so they can adjust the delivery schedules to your site.
 - » Let them know that you will be communicating with them about the break as it progresses.

- » Do not transfer feed from a PEDV-positive site to a PEDV-negative site.

Transporters

- Assign dedicated equipment to the site, especially to move weaned pigs and culled animals.
- Communicate with the sites that just received your weaned pigs to make them aware of the positive diagnosis.
- Ensure transport equipment is properly cleaned, disinfected and dried before use.

Mortality Pickup

- If using a commercial mortality pickup, make them aware so if they have flexibility in their routes they can make adjustments.

Part-time Workers, Contractors, Electricians, Maintenance Staff

- Inform everyone who has been on the site or helped with load-out, chores or repairs so they can take precautions and measures to prevent spread to their own or somebody else's pigs.
- Check to be sure that there is adequate on-farm equipment for repairs and maintenance of the farm facilities to avoid transporting equipment on or off the farm.

(continued)

Veterinarians

- Ask your veterinarian to contact the veterinarian of the site where, within the last two weeks, any pigs were purchased and brought onto your site or shipped off of your site and received.
- Ask your veterinarian to contact the veterinarians of neighboring herds.
- Ask your veterinarian to contact the veterinarian of multiplication herd(s) that may be the source of replacement breeding stock for your operation.

Contain the virus to your site and avoid further spread of the virus

Ensure that the Line of Separation, which marks the separation from outside the facility to the inside area with your people and pigs, is strictly enforced.

Refer to the Pork Checkoff fact sheet titled *Establish a Line of Separation: Help Control the Spread of PEDV and Other Swine Diseases* for more detailed information.

Site stabilization

The objective should be to establish herd immunity quickly by assuring all animals are exposed and infected as soon as possible.

Following the outbreak, exposure or feedback, mark each sow card when a sow has shown at least one of the PED clinical signs.

Natural infection is rapid (incubation = one day) but may need to be augmented by intentional exposure.

The sooner ALL pigs are infected, the sooner the shedding of PEDV will be limited (herd immunity established), thereby minimizing the chances of PEDV becoming endemic.

- Rapid herd exposure and induction of immunity allows a more rapid return to normal production.

Herd closure

- Work with your breeding stock replacement supplier to develop a strategy to manage replacement gilts.
- Determine the number of replacement animals that you can inventory for the site.
 - » For PEDV elimination as the goal, you may need to make sure the herd is closed for at least 120 days. Additional sites may be needed to do this. Check the biosecurity capabilities of these sites taking into account the local swine density since your replacement animals will need to be exposed.

- Develop a timeline with your genetic supplier for animal delivery, preferably with staged ages and weights. If delivery must be delayed, gilts will need to be exposed as soon as possible.

Feedback

- Feedback can be used to ensure uniform exposure of the herd (gilts and sows) leading to immunity:
 - » Contact your herd veterinarian to develop a specific strategy for your herd, based on its unique attributes.
 - ✓ Procedures and number of times to feedback will vary with sites. Work with your veterinarian to track the initial outbreak to avoid multiple, unnecessary feedback procedures.
 - » Ensure all animals get exposed.
 - ✓ Mark each sow card when feedback occurs and when clinical signs (diarrhea, off feed, lethargy) are observed. Identify animals that do not show clinical signs or have questionable exposure so that these animals may be blood tested to ensure seroconversion.
 - » Wait a minimum of three weeks following exposure to collect blood samples to be tested.
 - ✓ Work with your herd veterinarian and diagnostic lab to determine the appropriate tests to run.

Approximately three weeks after acute infection or feedback exposure, piglet condition will improve but expect that they may still be PEDV positive. Production of PEDV negative pigs may take up to 120 days after the initial outbreak and will depend on the success of your exposure, cleanup and biosecurity procedures.

Lactation management

Expect the severity of diarrhea to be worse in piglets consuming milk.

If adequate space is available and your nursery staff can manage it, consider early weaning all piglets during the initial stages of the outbreak and in particular those piglets not yet exhibiting clinical signs. Early weaning can save piglets during the initial outbreak by removing them before they are exposed to PEDV.

Once exposure is completed and clinical signs have subsided:

- Implement strict McREBEL (Management Changes to Reduce Exposures to Bacteria to Eliminate Losses) procedures. McREBEL is a management protocol that involves:
 - » Only move piglets to balance litter numbers during the first 24 hours of their life
 - ✓ Allow no pigs held back at any stage in the facility.
- In herds that have already been infected with PEDV and it has spread through the farrowing house, maximize weaning age to allow for as big a pig as possible in the nursery. Bigger pigs can handle infection better than smaller, younger pigs.

Pathogen load reduction - Cleanup

Once the herd has been completely exposed to PEDV and severity of diarrhea begins to subside, it is important to reduce the environmental load of virus on the site.

- Don't risk the virus load in the environment overpowering the immunity that the sows are trying to pass on to the piglets in the milk.
- Do not do multiple feedback procedures unless directed to by your veterinarian.
- Completely wash and disinfect alley ways, hallways and load-outs after animal movements have occurred. Inspect the facilities to ensure complete washing and disinfecting has been carried out.

Once there are no more clinical signs in gestation wash down the entire facility.

- The goal is to further reduce the virus load in the environment in pursuit of elimination.

Continue to wash and disinfect complete farrowing rooms and, when possible, allow to dry overnight. Disinfect the facility using products according to label directions. Barn lime can be applied to flooring, gestation and farrowing stalls, and walls to help dry the pig's environment and potentially reduce viral load.

Biosecurity

- For additional biosecurity guidelines, go to pork.org/PEDV

Positive Diagnosis of PEDV in Nursery, Finisher or Wean-to-Finish Sites: What Next?

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to pork producer. PEDV transfers via feces and survives in manure for extended periods of time. Anything that is contaminated with pig manure can be a source of infection for pigs, including feed. **There are a number of important actions to take once the diagnosis of PEDV has been confirmed at your site.**

Good-neighbor policy, **COMMUNICATE**

Production system

- If in a production system, notify the main office so that biosecurity protocols are adjusted.
- Make sure all supervisors are notified immediately.

Neighbors

- Contact your neighbors who have pigs in your area and let them know that there has been a positive diagnosis and that you are working to control the infection on your site.
 - » As a general rule, notify farms located within one to two miles.

Feedmill

- Contact the feedmill if you are purchasing feed.
 - » Let them know your herd is positive so that they can adjust their delivery schedules and trucks to your site.
 - » Continue to communicate with them about the status of the break as it progresses.
 - » Do not transfer feed from a PEDV-positive site to a negative site.

Transporters

- Communication is important. It is especially important if marketing pigs at the time of the diagnosis or if weaned pigs or feeders were just delivered.
 - » This allows them to make sure their equipment is properly cleaned and to adjust the order of transport of the rest of your pigs.

Mortality pickup

- If using a commercial mortality pickup, let them know your farm's PEDV status. Rendering trucks can often make adjustments to routes.

Vendors, part-time workers, contractors, vaccination crews, electricians, maintenance staff

- Notify anyone that has helped with load-out, chores or repairs and general maintenance so they can take precautionary measures and prevent spread to their own or someone else's pigs.

Contain the virus to your sites and avoid further spread of the virus

- Establish and respect the Line of Separation which marks the separation from outside the facility to the inside area of people and pigs.
- Set up a bench-entry system or establish a clear Line of Separation to the site to avoid carrying material out of the barn.
 - » Create a clean crossing of the Line of Separation (bench or entryway) by using separate coveralls and boots for the site. Cover up with gloves and make sure to properly dispose gloves or clean your hands as you leave the site.
 - » Leave all materials in the barn except laundry, if a service is used.

- Make sure not to share any equipment with other sites.
- Make sure to change clothes and shoes and shower before leaving a positive production facility. A clean crossing should prevent you from spreading the disease.

Site stabilization

- Infection tends to move rapidly through the group/site. The sooner the infection goes through the group, the sooner the pigs will reach the point when virus shedding is limited and there is uniform exposure of the herd. Clinical signs should decrease at this point. Consult your veterinarian.

Clean up

- Once there are no more clinical signs, wash down and disinfect alleys, load-outs, etc., to help to reduce the viral load in the environment. Barn lime can be applied to floors and chutes help dry these areas.
- Pressure wash and disinfect once the site can be emptied.

Mortalities

- Make sure to properly and quickly dispose of mortalities.
- Once clinical signs have subsided clean the area where dead pigs are removed if at all possible.
- If gravel and weather permits use a drag around the facilities perimeter to make sure that all material gets to the surface and are exposed to sunlight.

For additional biosecurity guidelines, go to www.pork.org/PEDV

Elimination of PEDV from a Nursery, Finish or Wean-to-Finish Site

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer.

PEDV transfers via feces and survives in manure for extended periods of time. Anything contaminated with pig manure can be a source of infection for pigs, including feed. **There are a number of important actions to take once the diagnosis of PEDV has been confirmed at your site.**

Empty the site by moving all pigs to finishers or market all the animals from the site:

- Make sure all animals and feed are removed from the site. Do not transfer feed from a PEDV-positive site to a negative site.
 - » Include any mortality that has occurred.
- Clean up all manure, feed spills and wood shavings around the building.
- Drag the rock perimeter around the facility to expose materials to sunlight and UV radiation.

Water lines and rodent control:

- Drain water lines and bleach.
- Replenish rodent-control baits.

Begin detailed cleanup:

- Do a complete wash of the facility to remove as much matter as possible.
- Use a soap/detergent to help with the removal of organic matter.
 - » Don't try to do it all in one washing, but try to get as much as possible with the first wash and repeat as needed.
- Clean, disinfect and remove any unnecessary materials or equipment from the site.
- Any equipment that will remain at the site must be thoroughly washed, disinfected and dried.
- Make sure to include office, load-out and any storage areas when cleaning and disinfecting.

- Don't forget equipment that is in the barn:
 - » Discard any cracked plastic panels, sort boards or paddles that cannot be properly cleaned.
- Inspect the site after the clean up:
 - » Make a check list and do methodical in-pen inspections so nothing is missed. Any feed, hair or manure found suggests the barn needs cleaning again.
 - » Make sure the barn is dry before inspection, it is difficult to do a good job of inspection when wet.
 - » Use a flashlight and screwdriver to check cracks to make sure everything is clean.
 - » Use sidewalk chalk to mark spots that need to be rewashed. This makes it easier to not miss something on the final wash.
- Repeat with one final inspection prior to disinfection to confirm that the facility is completely cleaned.

Disinfection:

- Once everything passes dry and cleaning inspection, disinfect according to disinfectant manufacturer recommendations.
 - » Use a disinfectant suitable for PEDV referencing disinfectant information that can be found on aasv.org.
 - » Allow the facility to completely dry after the disinfectant is applied.

Downtime:

- Maintain downtime as long as can be accommodated. Site needs to completely dry between inspections and after disinfection.

Chutes, load-outs and area in front of entry:

- Chutes and load-outs must be cleaned and inspected like the barn.
- Repainting or relining the chute is a good way to make sure the wood is clean.
- Put down new rock in front of load-out area and entry to ensure a clean surface.

How to Verify PEDV-Negative Status After the Virus Is Eliminated on a Farm

Porcine epidemic diarrhea virus (PEDV) is a highly contagious enteric pathogen causing severe diarrhea and piglet mortality when introduced into a sow farm. To control disease caused by PEDV, some farms may attempt to eliminate the virus from the farm. However, herd reinfection with PEDV is possible so biosecurity precautions need to remain in place. This process is complicated by variations in PEDV virulence (its ability to cause disease) as well as other disease-causing enteric virus such as porcine deltacoronavirus (PDCoV).

Appropriate testing methods to determine if PEDV is still present on the farm:

Testing needs to include both replacement animals after entry and commingling with resident sows and piglets.

Testing of replacement animals:

- Introduction of PEDV-negative, unexposed replacement animals will be required to ensure that a herd achieves or maintains PEDV-negative status.
- Testing replacement animals after they have been commingled with the sow-farm adult animals for at least 30 days is indicated:
 - » PCR testing of feces from introduced animals over a 30-day period (expected negative).
 - ✓ Testing is performed on feces from gilts with loose feces or pooled feces from gilts one and three weeks post-placement.
 - ✓ If gilts are in pens, oral fluids can also be used as the sample on the PCR test (one rope/pen).
 - » Bleed 30 gilts each month for serological testing (antibody detection) for four consecutive months – (expected negative).

Testing of suckling piglets:

- Select piglets most likely to be shedding (i.e. those with diarrhea or ill-thrift).
- Collect and pool the fecal samples by litter.
- If no piglets are showing diarrhea then collect four Swiffer or 4x4 gauze samples (one Swiffer or 4x4 gauze can be used to sample up to 12 farrowing stalls) from piglet feces in farrowing stalls.
- PCR test at least 12 pooled specimens per month (or three per week).

If all testing remains negative at all test times, for a minimum of four months, consider the PEDV eliminated. Work with your veterinarian to develop a comprehensive PEDV monitoring program. Always work with the diagnostic laboratory for a complete interpretation of all testing results.



Procedures for Swiffer or 4x4 Gauze Environmental Sampling

1. Place 10 to 20 ml of phosphate buffered saline (PBS) in a bag with a Swiffer or 4x4 gauze.
2. Massage the bag so that the Swiffer or 4x4 gauze will absorb the PBS.
3. With gloved hands, carefully remove Swiffer or 4x4 gauze from inside the bag.
4. Wipe/sample a 1-square-foot area (or the designated number of farrowing stalls).
 - » If sampling on a substrate that is relatively clean and dry, then enlarge the sampling area to increase the chances of finding any virus present.
5. Put the Swiffer or 4x4 gauze back into the bag.
6. Squeeze PBS from Swiffer or 4x4 gauze inside the bag and then pour PBS into a tube for submission, in a cooler on ice, to the diagnostic laboratory.
7. Discard used Swiffer/4x4 gauze.



Diseases like to “Hitch a Ride,” so separate yourself from cross contamination. Control the accidental spread of disease!

The organisms that cause disease in pigs (bacteria, viruses and parasites) can survive in different types of materials. Organic matter (shavings, manure), feed, water, mud and snow can all carry diseases. Contaminated boots, clothing, tires, undercarriages, trailers, shovels, winter panels, sorting panels and people’s clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or packing plant, can increase risk for disease spread because boots and trailers can become contaminated with diseases the farms you serve are trying to keep out. Assume every site you touch is a risk. Do not be responsible for transferring this disease.

Testing of Replacement Breeding Animals for PEDV Status

Porcine epidemic diarrhea virus (PEDV) is a highly contagious enteric pathogen of swine associated with severe diarrhea and piglet mortality if introduced into a sow farm. The intent of this guidance is to outline appropriate PEDV testing for replacement animals. This process is complicated by variations in PEDV virulence and other pathogenic enteric virus such as porcine deltacoronavirus (PDCoV).

Are these replacement animals negative (or naive) to PEDV?

- Work with your veterinarian and the breeding stock supplier to establish the health status of the supplier herd.
- Upon gilts arriving into isolation/gilt developer unit:
 - » Always pursue clinical signs and collect any abnormal feces for PCR testing. Ensure that samples are collected from multiple pens.
 - » Collect samples within one week after delivery and again close to movement to sow farm (e.g. one week prior to movement).
 - ✓ Collect oral fluids for PCR testing from a minimum of four pens.
 - ✓ Alternatively, collect feces from 20 animals and pool in groups of five for PCR testing.
 - » Collect serum for antibody detection from 30 gilts when placed in isolation or developer unit and again one week prior to shipment to the sow farm.
- Interpretation:
 - » All testing results should be negative.
 - » Always work with the diagnostic laboratory for a complete interpretation of all testing results.

Have these replacement animals been exposed to PEDV, but now are no longer shedding PEDV?

- Always pursue clinical signs and collect any abnormal feces for PCR testing. Ensure that samples are collected from multiple pens.
 - » Collect samples within one week after delivery and again as close to movement to sow farm (e.g. one week prior to movement).

- ✓ Collect oral fluids for PCR testing from a minimum of four pens.
- ✓ Alternatively, collect feces from 20 animals and pool in groups of five for PCR.
- » Collect serum for antibody detection from 30 gilts prior to shipment to the sow farm.
- Interpretation:
 - » Serum testing results to confirm exposure are expected to be positive (antibody is present due to known previous exposure).
 - » PCR testing results should be negative.
 - » Always work with the diagnostic laboratory for a complete interpretation of all testing results.

Diseases like to “Hitch a Ride,” so separate yourself from cross contamination. Control the accidental spread of disease!

The organisms that cause disease in pigs (bacteria, viruses and parasites) can survive in different types of materials. Organic matter (shavings, manure), feed, water, mud and snow can all carry diseases. Contaminated boots, clothing, tires, undercarriages, trailers, shovels, winter panels, sorting panels and people’s clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or packing plant, can increase risk for disease spread because boots and trailers can become contaminated with diseases the farms you serve are trying to keep out. Assume every site you touch is a risk. Do not be responsible for transferring this disease.

General Biosecurity Practices for Non-farm Personnel

The introduction of porcine epidemic diarrhea virus (PEDV) into the United States highlights the need to follow important biosecurity steps in order to avoid infection on a farm. Diseases such as porcine epidemic diarrhea virus (PEDV) and porcine reproductive and respiratory syndrome (PRRS) can create significant financial losses to producers. Therefore, it is very important that all farm visitors follow basic biosecurity steps to avoid introduction of PEDV or other swine disease pathogens.

Farm personnel who are not involved in day-to-day operations, but whose activities may necessitate a farm visit (inside or outside of the animal housing) include:

- State animal health authorities
- PQA Plus® advisors
- Swine extension specialists
- State and environmental management staff
- Support staff from supply or feed companies
- Maintenance specialists (e.g. electricians, plumbers, etc.)
- Veterinarians
- Nutritionists

Prior to visiting a farm:

Be informed

1. Contact the owner/manager of the farm to determine if there are any downtime requirements prior to visiting the farm. High-health status farms may require an extended period of downtime.
 - At a minimum, maintain an overnight period of downtime between farm visits.
 - » High-health status farms such as a boar stud may require additional nights downtime prior to a visit.
 - International travel may require up to five days downtime before a farm visit. (To view resources for downtime, visit pork.org/resources).
 - If you are ill with flu-like symptoms, postpone the farm visit until you are free of symptoms for at least 24 hours. Swine can get influenza virus from people.

2. Ask the owner/manager to detail any farm-specific biosecurity protocols that you will need to follow during the visit if different from the minimum standards listed earlier. Request information about the flow of animals on the farm.
3. Assess what activities will be required for the farm visit:
 - Will the visit involve only an outside assessment or will it involve entering into animal housing facilities?
 - Does the farm have shower facilities on site or will additional cover-up clothing and footwear be needed?
 - Always use the farm resources first before bringing in any additional items. Ask the farm manager prior to the visit if personal items can be brought in such as undergarments or a knee or ankle brace.
4. Ask about the current herd health status.
 - If the farm is undergoing a disease outbreak, work with the producer and herd veterinarian to postpone the visit until the herd has recovered.

Be prepared

1. Carry an adequate amount of supplies (disposable coveralls, boots, clipboard, pens, etc.) in the event the farm does not have them:
 - Store all clean coveralls and equipment in a clean tote box.
 - Keep garbage bags in the clean tote and place all used equipment/coveralls into the bag after the visit.
 - Place all used equipment and trash in a garbage bag in a separate location of the vehicle (keep used equipment away from clean equipment).
 - Store disinfectant wipes in the clean tote in order to disinfect equipment prior to and after a farm visit.
2. Prior to the visit, inspect the vehicle to verify that:
 - The exterior of the vehicle was washed and disinfected and was allowed to dry overnight from the last farm visit (wash vehicles at a municipal or local carwash).

- » Pay special attention to the wheel wells and undercarriage.
- The interior of the vehicle is free of dirt and debris and all trash is removed and the steering wheel is wiped down. Visit aasv.org for more specific information on disinfectants.

Downtime is the time away from other livestock including fairs, shows, sale barns, livestock farms or any other location that houses live swine. Extra downtime can also be needed for any international visitors.

At the farm:

Parking

1. Park in the designated parking area for the farm. Obey all signage regarding access to specific areas.
2. If no parking area exists, park in a location away from the livestock barn or waste-control area that is on gravel or hard surface or ear the edge of the public road close to the location.
3. Avoid parking or driving in muddy areas on the farm.
4. Keep windows shut to prevent pests from entering the vehicle.

Visiting the farm

1. If not entering animal housing areas and no farm clothing is provided, change into disposable coveralls and boots at the vehicle side. Make sure to put on first set of disposable boots before you get out of the vehicle and step on the ground. Double boots may be required depending upon terrain to avoid exposure from rips/tears. All equipment should be clean, disinfected, dry and ready to use prior to arriving at the farm.
 - Know and understand the concept of the Line of Separation.
 - Refer to *Establish a Line of Separation: Help Control the Spread of PEDV* fact sheet found at pork.org/PEDV



Line of Separation = line dividing the area that is to be used by the farm for live animals (often referred to as the *clean area*) and the area that is outside of the live animal area (the *dirty area*). Do not cross directly from outside of a farm into the live animal area.

2. If having to visit both the inside and outside of the farm, perform the inside farm visit first then finish with any outside assessment.
 - Follow all on-farm biosecurity steps to enter into the live-animal areas:
 - » Leave all of your personal items in the vehicle and do not bring them into the farm. Personal items include hats, ball caps, cell phones (and all other electronics), watches or jewelry.
 - » Do not bring any food or drink into the farm.

At the completion of the visit:

Prior to leaving

1. Contain all garbage and used equipment in a garbage bag and place in location away from the clean supplies.
2. For non-disposable equipment wipe down with disinfectant wipes and place in a separate bag for future cleaning.
3. Remove dirty boots and coveralls as you are entering the vehicle. Place in respective “dirty” containers or bags. Clean hands with wipes or hand sanitizer.
4. After you have left the farm, wash and disinfect the exterior of the vehicle to remove any mud and debris. Vacuum the interior of the vehicle and remove all trash and wipe down the steering wheel with a disinfectant wipe.

At home

1. If using cloth coveralls and rubber boots, clean and launder all clothing/footwear and allow for at least 24 hours downtime after cleaning and drying before use on another farm. Once fully clean (no organic matter visible), be sure to also disinfect rubber boots.
2. If the farm does not have a shower facility, shower at home and allow for overnight downtime at a minimum before going to another farm.

For additional resources about farm biosecurity, visit pork.org/PEDV.

Biosecure Mortality Management for PEDV Control

Always assume the facility to manage mortalities, such as an animal disposal unit (ADU) or a compost pile is contaminated with swine pathogens such as porcine epidemic diarrhea virus (PEDV), TGE, PRRS, *Brachyspira sp.*, APP, etc. Therefore, it is very important to follow strict biosecurity measures when working around a mortality management site. The rendering truck, equipment and personnel operating around these areas can move infectious material from one site to another. ***Infection with PEDV and other pathogens can create tremendous financial losses to a pork producer.*** This is why it is important to establish a biosecure and responsible way to manage mortalities.

Location of the Composting Site

- Composting is an effective disposal method for dealing with PEDV-related mortalities. However, it can still present a risk for infection to other swine locations.
- Place the composting site in a location away from other livestock. Prevent access to wildlife.
- The compost site should not use the same traffic flow/driveway that is used for the livestock facilities.

Location of the ADU

- Place the ADU in a location away from other livestock. Prevent access to wildlife.
- Two-sided entrance points ensure that your farm vehicle does not drive over the same path as the rendering truck. Have clear instructional signs in a highly visible location illustrating the Line of Separation for the rendering truck driver.

Procedures for Hauling Mortalities to the Composting or ADU Site

- Transporting mortalities to the ADU/composting site should be the last task of the day.
- Mortalities should be placed at the Line of Separation so that those transporting the mortalities do not have to cross to the pig side of the Line of Separation. When the building doorway is the Line of Separation, place the mortalities just inside the doors.
- When leaving the barn, cross the Line of Separation to the outside of the barn and then put on coveralls and boots that will only be used for the mortalities run. (A different color of coveralls and boots is recommended for this task to help

keep these items from entering the barns).

- Any tractor, truck, or equipment that will cross to the pig side of the Line of Separation for animal transport the mortalities site needs to be cleaned, disinfected and dried before use.
- Load today's mortalities with minimal contact with buildings and farm staff. Cover up with protective gear or clothing if necessary to cross the Line of Separation (and have the Line of Separation clearly marked).
- When working an ADU:
 - » Approach the ADU from the farm side.
 - » Place mortalities in the ADU box without crossing the path of the rendering side.
 - » Close the lid on the ADU or cover it securely.
- When done hauling mortalities, drive the tractor or truck to a secure location and thoroughly wash and disinfect the vehicle and all equipment used, including the interior of the tractor or truck. This process is necessary when hauling mortalities crosses back to the pig side of the Line of Separation.
- Leave the cleaned tractor/truck in a secure location to dry. Do not return it to the farm site until it is completely dry.
- Remove clothing designated for the mortalities chore. It is highly suggested that these items be washed in a different location from the pig site and returned clean and completely dry.
- Insure a clean crossing if re-entry into the farm facilities is required. Remove all contaminated protective gear and properly clean or dispose of them to insure nothing is brought back into the facilities.

Establish a Line of Separation: Help Control the Spread of PEDV and Other Swine Diseases

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer. PEDV transfers via feces and survives in manure for extended periods of time. Anything that is contaminated with pig manure can be a source of infection for pigs. Live-pig hauling is an essential part of the pork industry and can play a key role in the control of disease. All pork producers and transport drivers should be aware of the role they may play in the spread of PEDV and other swine diseases. In order to prevent the spread of PEDV from one farm to another, establish a line of separation.

The Line of Separation is defined as the line between the area that is to be used by the transporter and the area to be used by farm or market personnel. Be aware and be informed of where the line of separation is in every situation.

There may be multiple areas where the line of separation is drawn.

Be aware of where the Line of Separation is when arriving at a producer's site or at a market.

At the cab of the truck:



At the back of the trailer and the loading chute:



At the farm:



(continued)

Assume There is Risk!

- Approach every contact with a site or market as if it could contaminate your truck and trailer.
- Have a biosecure plan to manage the Line of Separation between you and the site. Examples include:
 - » Using dedicated storage containers to hold clean equipment for each movement.
 - » Using clean equipment for each movement of animals.
 - » Following a disposal plan to remove and contain used/contaminated equipment.

Examples are listed below:

Storage Containers



Clean Equipment



Disposal Plan



Diseases like to “Hitch a Ride,” so separate yourself from cross contamination. Control the accidental spread of disease!

The organisms that cause disease in pigs (bacteria, viruses and parasites) can survive in different types of materials. Organic matter (shavings, manure), feed, water, mud and snow can all carry diseases. Contaminated boots, clothing, tires, undercarriages, trailers, shovels, winter panels, sorting panels and people’s clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or packing plant, can increase risk for disease spread because boots and trailers can become contaminated with diseases the farms you serve are trying to keep out. Assume every site you touch is a risk. Do not be responsible for transferring this disease.

Create a Clean Crossing: Help Control the Spread of PEDV and Other Swine Diseases

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer. PEDV transfers via feces and survives in manure for extended periods of time. Anything that is contaminated with pig manure can be a source of infection for pigs. Live-pig hauling is an essential part of the pork industry and can play a key role in the control of disease. Live-haul drivers should be educated about the risks PEDV and other swine diseases bring to the pork industry. In order to prevent the spread of PEDV from one farm to another, create a clean crossing.

Create A Clean Crossing

If you must cross over areas with farm, market personnel or live-haul equipment.

Cover-up

- Wear protective gear when crossing a line of separation:
 - » Boots
 - » Coveralls
 - » Gloves



Contain

- Dispose of or store away contaminated supplies



(continued)

Clean up to Remove Risk

- Clean up by washing and disinfecting all contaminated supplies and dispose dirty items in a garbage bag for removal.



Assume There is Risk!

- Approach every contact with a site or market as if it could contaminate your truck and trailer.
- Have a biosecure plan to manage the Line of Separation between you and the site.
 - » Using dedicated storage containers to hold clean equipment for each movement.
 - » Using clean equipment for each movement of animals.
 - » Following a disposal plan to remove and contain used/contaminated equipment.

Storage Containers



Clean Equipment



Disposal Plan



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The organisms that cause disease in pigs (bacteria, viruses and parasites) can survive in different types of materials. Organic matter (shavings, manure), feed, water, mud and snow can all carry diseases. Contaminated boots, clothing, tires, undercarriages, trailers, shovels, winter panels, sorting panels and people’s clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or packing plant, can increase risk for disease spread because boots and trailers can become contaminated with diseases the farms you serve are trying to keep out. Assume every site you touch is a risk. Do not be responsible for transferring this disease.

Transportation Biosecurity Protocols for PEDV Control

Key Point

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer. PEDV transfers via feces and survives in manure for extended periods of time. Any thing that is contaminated with pig manure can be a source of infection for pigs. Live haul is an essential part of the pork industry and plays a key role in the control of disease. Live-haul drivers should be educated about the risk PEDV is to the pork industry.

Ensure you are Prepared for Swine Transportation

1. The market truck should be prepared for hauling market hogs.
 - a. The cab of the truck, including floor-boards, pedals, steering wheel, gear shift handle, door handles, etc., should be cleaned and disinfected between loads.
 - b. The trailer should be
 - Washed clean and free of any visible manure or shavings,
 - Disinfected with an appropriate disinfectant, at the correct rate, for the proper contact time, and applied so that all surfaces are covered, and
 - Allowed to dry completely.
 - » When used in conjunction with cleaning and disinfection, thermal-assisted drying of trailers at 160° F for 10 minutes will eliminate PEDV and provide another safeguard against the transmission of the virus.
 - c. All equipment, including sort-boards, rattle-paddles, electric prods, etc., need to be thoroughly cleaned, disinfected and dried.
 - d. Clean boots, coveralls, gloves, knee pads, etc., should be used for each load and stored in a designated clean area. A separate area for storage should be used for these articles after they are used and until they can be cleaned and disinfected for future use.
2. The production site should be ready for animal movement
 - a. All load-out equipment should be clean and in good working order
 - b. The load-out area and chute should be clean and ready to market pigs
 - c. Communicate where the Line of Separation is located. This marks the separation between the production facilities, its animals and its workers from trucks, trailers and people outside of the production facility.
 - An effective Line of Separation is the back of the trailer, but may be at the barn door, the chute or gate.
 - Be sure the Line is clearly marked and visible to all.
 - Provide plastic disposable footwear and a place to dispose of the footwear for the driver if they must to cross the Line of Separation.
 - d. There should be enough trained farm personnel available to help load pigs from the site.
 - *The truck driver should never cross the Line of Separation to help move pigs from the barn.*

...continued on page 2

3. Communication between the livestock hauler and livestock owner or site manager should take place. Expectations for loading and unloading animals should be communicated prior to arrival.

- a. A clear Line of Separation should be identified and communicated.
 - No human foot traffic is allowed to cross the Line of Separation from either direction.
 - If animals are being loaded for slaughter, farm personnel move the animals up to the Line of Separation.
 - The driver handles the animals after they cross the Line of Separation.
- b. No farm equipment or transportation equipment may cross the Line of Separation to be shared for loading hogs
- c. *Specific requirements may be needed for different stages of production or health status. A more detailed protocol may be required in many operations or production systems.*
 - If biosecurity protocols for the farm are not completely clear, ask the farm personnel or site manager for guidance.

Responsibilities during the Loading Process

1. Livestock haulers
 - a. Must stay on the out-bound side of the Line of Separation at all times for load-out.
 - b. No driver equipment may cross the Line of Separation or be used in the barn.
 - c. No pigs should be allowed to exit the truck during the load-out process.
 - d. The driver should remove all boots and clothing on the truck side of the Line of Separation.
 - All dirty boots and coveralls should be placed in a designated area, outside the cab (for

- e. Hand paperwork to farm load crew personnel away from the truck and barn.

2. Loading crew or farm personnel

- a. The farm load crew must observe the Line of Separation at all times.
 - If the Line of Separation is crossed, farm personnel **MUST** follow reentry biosecurity measures (such as shower in/out or change of clothes/boots and wash of hands) before they can resume the loading process.
 - Dirty coveralls or gloves should be placed in a container or directly into a washer.
 - Dirty boots should be placed where they can be washed and disinfected away from farm clothing. Do not place them where everyday foot traffic occurs.
 - Do not share loading equipment with livestock haulers.
- b. Do not cross foot traffic at any time with livestock haulers including after pigs are loaded.
- c. No farm equipment should be shared with the livestock haulers.
- d. Do not allow drivers to help load pigs out of the barn.
- e. Do not allow drivers to fill out paperwork in the office.

Responsibilities after the Loading Process

1. Farm personnel should clean and disinfect the load-out area immediately after the transport vehicle has been loaded and pulled away.
2. Farm personnel that cross the Line of Separation to clean the chute or load out area must follow the biosecurity protocols of the site, such as shower in/out or change of clothes and boots and wash hands.

Diseases like to “Hitch a Ride,” so separate yourself from cross contamination. Control the accidental spread of disease!

The organisms that cause disease in pigs (bacteria, viruses and parasites) can survive in different types of materials. Organic matter (shavings, manure), feed, water, mud and snow can all carry diseases. Contaminated boots, clothing, tires, undercarriages, trailers, shovels, winter panels, sorting panels and people’s clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or packing plant, can increase risk for disease spread because boots and trailers can become contaminated with diseases the farms you serve are trying to keep out. Assume every site you touch is a risk. Do not be responsible for transferring this disease.

Transportation Biosecurity Recommendations for PEDV Control at Packing Plants

Key Point

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer. PEDV transfers via feces and survives in manure for extended periods of time. During an outbreak of PED, affected animals shed a large amount of the virus into the environment. Contamination of trucks, equipment, clothing and footwear with feces can spread the virus.

Because of the extreme ease of PEDV to spread, it's very important that everyone do their part to prevent the spread of this disease. Some prudent steps to help achieve this goal include the following:

Driver, Truck and Trailer

1. For each load of pigs, wear/use clean boots, coveralls, gloves, knee pads, etc.
 - After each load, place dirty boots and coveralls in a separate container for disposal or laundering. Do not contaminate the cab with dirty outerwear.
2. Between loads, clean and disinfect the cab of the truck, including floorboards, pedals, steering wheel, etc. Anywhere outside the cab of the truck should be seen as potentially contaminated. Therefore, to keep the cab as clean as possible:
 - Use disposable footwear and coveralls while outside of the cab on the dock, in the yards, and inside of the facility. Dirty footwear should not enter the cab of the truck.
 - Limit foot traffic on the dock or in the yards.
 - Avoid unnecessary foot traffic into other areas of the market.
 - Do not enter another truck's trailer or cab.
 - Keep cab as clean as possible. Use disinfectant solution and wipes where possible.

3. Between loads, wash and disinfect the trailer and all equipment and allow to dry completely.
 - Always use your own equipment and do not share equipment with other truckers.
 - Before cleaning and disinfection takes place, assume that trailer and equipment are contaminated.
4. Note: Always ask the market about their biosecurity practices and then abide by them. (i.e. Some plants may require drivers to stay in their cabs while others may have different requirements). See additional transport biosecurity recommendations at pork.org/PEDV.

At the Market

1. Receiving dock or chute should be scraped between loads to keep as clean as possible.
2. Establish a Line of Separation that marks the separation between the market facility and the trucks, trailers and people outside of the market facility. (See Pork Checkoff's fact sheet, *Establish a Line of Separation: Help Control the Spread of PEDV and Other Swine Diseases*.)
 - An effective Line of Separation is the back of the trailer, but may be at the chute or gate on the unloading dock.
 - Provide plastic disposable footwear and disposable coveralls for anyone that needs to cross the Line of Separation.

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- Where possible, when unloading, live-haul personnel should move the animals up to Line of Separation and then the market personnel handle the animals on the other side of the Line of Separation.
 - » If using shavings at the trailer exit, be sure they are clean and kept far enough back so they don't cross the Line of Separation.
 - » If the Line of Separation is crossed, boots and hands need to be washed. Disposable gloves, coveralls and plastic boots should be used and disposed of properly for each Line of Separation crossing.
 - Take precautions so that market equipment and transportation equipment do not cross the Line of Separation in the unloading process.
 - » If it is necessary for equipment to cross the Line of Separation and it is a piece of equipment that can withstand disinfectant solution, then it should be cleaned, disinfected and dried each time it crosses the Line of Separation.
 - » If plant equipment must be used for unloading, it should be cleaned and if possible disinfected between trucks.
3. When unloading the pigs, take precautions so that no pigs are able to re-enter the trailer.
 4. Provide procedures that allow for an exchange of paperwork that avoids cross contamination between market and driver.

Disinfection Tips

Several disinfectants have been demonstrated to effectively inactivate PEDV. The list includes:

1. Oxidizing Agents [e.g., potassium peroxymonosulfate (Virkon S¹) or sodium hypochlorite (bleach)]
2. Sodium Carbonates (e.g., soda ash)
3. Lipid Solvents (e.g., ethyl alcohol)
4. Strong Iodophors in Phosphoric Acid (e.g., iodine)
5. Phenolic Compounds (e.g., 1 Stroke Environ² or Tek-Trol³)
6. Aldehydes (e.g., Synergize⁴)
7. Accelerated Hydrogen peroxide⁵

Always clean before disinfecting as the disinfectants are less effective when organic material (i.e., feces) is present. Cleaning with hot water and detergents will assist with organic material removal. To avoid dilution of the disinfectant remember to drain off standing water prior to applying the disinfectant. After cleaning and applying disinfectant allow for a drying period to further inactivate any viruses present.

For the best efficacy disinfect with an appropriate disinfectant, at the correct rate, for the proper contact time, and apply so that all surfaces are covered.

Always mix disinfectants according to label directions. Misuse of a product is a violation of EPA regulations.

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1 A product of Antec Intl., Ltd.

2 A product of Steris Corp.

3 A product of ABC Compounding.

4 A product of Preserve Intl.

5 A product of Virox Technologies, Inc.

Biosecure Truck Wash Protocols for PEDV Control: Recommendations for Truck Wash Facilities

Key Point

Infection with porcine epidemic diarrhea virus (PEDV) can create tremendous financial losses to a pork producer. PEDV transfers via feces and survives in manure for extended periods of time. Anything that is contaminated with pig manure can be a source of infection for pigs. Truck wash facilities are an essential part of the pork industry and plays a key role in the control of disease. All truck wash personnel should be educated about the risks PEDV is to the pork industry.

Basic Guidelines for Sanitation, Disinfection, Drying and Downtime

- Proper cleaning prior to disinfection is a critical step for preventing disease spread. The exterior and interior of any trucks and trailers must be thoroughly cleaned, washed, disinfected and completely dried prior to use.

This involves 5 steps

1. Removal of all manure and bedding
 2. Soaking with soap and/or degreaser
 3. Pressure washing with hot water is most effective vs. cold water wash
 4. Disinfecting by foaming with an appropriate disinfectant
 5. Drying
- The trailer and all equipment must be free of visible manure, shavings and dirt prior to disinfection.
 - The use of wash soap or degreasers can decrease cleaning time versus just using water alone.
 - Disinfectants should be used on trucks and trailers only after they have been cleaned because manure and dirt will inactivate and reduce the effectiveness of most disinfectants.
 - » Check on the disinfectant's label to ensure it mixes safely with any cleaning product or wash soap that is being used.
 - » Follow label directions when using disinfectants to ensure the disinfectant is being used at the proper concentration and temperature.
 - » Follow label directions for adequate contact time to ensure effectiveness.

- » Using disinfectants in a manner other than what is on the label may decrease effectiveness or may be unsafe.

Drying helps inactivate pathogens that cause disease and maximizes the benefit of disinfectants.

- Heat delivered to a trailer at 160° F for at least 10 minutes can assist in additional disinfection.
- If heat isn't available, fans or enough drive time to allow complete drying will help.

All manure and shavings for bedding cleaned from a trailer may contain pathogens that could cause disease.

- Dispose of these in a way that will prevent their spread to other trailers or locations.

Be aware of the source of water used for cleaning.

- PEDV can be infectious in recycled wash water for at least one week. Other disease-causing pathogens can survive for extended periods of time in recycled water so using fresh water for cleaning is especially important.

Pork producers will expect clean trailers are free of PEDV and other disease pathogens. On the second page of this document are key elements of a biosecure cleaning process.

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Biosecure Cleaning Protocol To Prevent Transfer of PEDV:

Before Entering the Wash Bay

1. Understand the traffic flow for entry and exit of clean and dirty vehicles.
2. The bay must be clean before the truck enters.
3. Scrape and sweep all manure, bedding and debris from the trailer.

In the Wash Bay

1. Clean out the truck cab.
2. Allow vehicle to thaw if necessary before washing.
3. Shavings bags, dirty rubber boots, used coveralls and gloves should be placed in designated locations (recycle bin, garbage or laundry).
4. Position all equipment including winter panels, brooms, shovels, sort board and paddles for washing.

Washing Process

1. Thoroughly rinse the interior cargo area free of manure and shavings (both decks even if both were not used). When using winter panels, pull all panels off of the vehicle and wash both sides.
2. Apply soap according to label directions, to all interior surfaces of pig space, working from the floor up.
3. Apply soap to the exterior of the trailer and the truck, including the trailer boxes.
 - Do not let the detergent dry on any surface.
4. Working from the top going down, high pressure wash the exterior of the trailer and truck first, then the trailer interior, including any winter panels, ramps, gates, crowd boards, brooms, shovels and dirty and clean boxes.

5. Apply disinfectant to all exterior surfaces. Then apply disinfectant to interior surfaces of the cargo area including any winter panels, ramps, gates, crowd boards, brooms, shovels and dirty and clean boxes.
6. Allow the appropriate contact time per instructions on the disinfectant bottle.
7. Clean and disinfect the cab. Be sure the pedals and floor of the cab are clean.
8. Before entering the cab to move the unit, remove the rubber boots and coveralls you are wearing and place in designated location or dirty box. Don't put or drag anything back into the truck.
9. Clean other surfaces of the cab (steering wheel, door handles, and dashboard) using a clean cloth that is wet with disinfectant solution or disinfectant wipes.

After Washing

1. Move the washing equipment to a "CLEAN" area and dry.
2. Park trailer on slope to drain excess standing water.
3. Use heat-assisted drying when possible and/or circulating fans or adequate drive time to assist in the drying process. Heating trailers to 160° F for at least 10 minutes will assist in disinfection for PEDV.

Final Items

1. Apply a pyrethrin insecticide inside the cab to kill any insects if needed.
2. Disinfect the exterior of the cab.
3. Rinse the floor of the wash bay area.
4. Return the hoses to the appropriate locations.
5. Turn the fan off.
6. Change out of the uniform used for washing and place in dirty laundry.

Biosecure Manure Pumping Protocols for PEDV Control: Recommendations for Pork Producers

Key Points

The introduction of the porcine epidemic diarrhea virus (PEDV) into the United States presents a challenge for manure pumping. **Infection with PEDV can create tremendous financial losses to a producer.** PEDV is transferred via feces and survives in manure and slurry for extended periods of time. Anything that becomes contaminated with pig manure can be a source of infection for pigs.

PEDV can survive in fresh feces for at least a week and between four and six months in a slurry in deep pits. PEDV can survive in manure and slurry for longer time periods during cold weather. Virus survival also appears to be highly influenced by the manure pH. Fresh swine manure typically has a pH around 7.0. During storage, manure pH generally will increase to around 7.5 to 8.5. As manure pH approaches 8.0, virus survival seems to be adversely impacted. Testing of manure pH prior to pumping may provide some insight into the likelihood of active virus present in the manure.

COMMUNICATE with the Manure Hauler:

- When scheduling with the manure hauler:
 - » Find out when the manure-hauling crew will be coming to the farm and require to be notified when they arrive.
 - » Ask where the manure hauling crew has been prior to coming to your site.
 - » Ask what biosecurity procedures the manure-hauling crew uses between customers to understand disease risks to your herd.
- Share contact information between the manure-hauling crew and farm personnel.
- Discuss your biosecurity expectations for the manure-hauling crew.
 - » Plan entrance and exit to the site to minimize cross-over between the path for the manure hauling crew and the rest of farm traffic or areas used by farm staff.
 - » Explain the routes that should be used to transport manure to fields.
 - » Discuss how any manure spills are to be handled.
- Explain to the manure hauler the locations of where the “**Line of Separation**” on the farm site.
 - » The Line of Separation defines the area that is to be used by the manure-hauling crew and the area to be used by daily farm traffic and personnel.
 - » Do not let the manure-hauling crew cross over the Line of Separation.
- **Inform all your employees of the biosecurity requirements discussed with the manure hauling crew.**

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Prior to the time of pumping COMMUNICATE with the Manure- Hauling Crew:

- The manure-hauling crew is not to enter the barns, office areas or walk over areas used by farm personnel and should never come in direct contact with the pigs.
- Farm personnel need to avoid any direct contact with the manure-hauling crew and the pumping and application equipment.
- IF farm personnel must cross over the Line of Separation they must do the following:
 - » **Cover-up** with clean protective gear (clean boots, coveralls, gloves) before crossing to the manure-hauling crew side of the Line of Separation.
 - » **Dispose of or properly contain** any contaminated clothing in plastic bags/totes before crossing back to the farm side of the Line of Separation.
 - » **Follow all shower-in or other biosecurity protocols** of the farm before crossing back to the farm side of the Line of Separation.
 - » Clean and disinfect any reusable gear before it is again moved and used on the farm side of the Line of Separation.

At the time of pumping and spreading manure:

- Farm personnel and your farm equipment need to avoid any direct contact with manure, manure hauling personnel, or the manure hauling equipment. Disease can be accidentally spread to other farms through manure contamination of people, vehicles and equipment.
- Adding lime to manure to raise the pH can inactivate PEDV. To ensure virus inactivation, approximately 50 lbs. of quick lime per 1,000 gallons of manure should be used to achieve a manure pH of at least 10. Lime should not be added directly to a storage pit, but may be added to a tank wagon used to haul manure to the application site. Raising manure pH can create significant odors from ammonia volatilization and can cause precipitation (settling) of solids from the manure. In a pit, these settled solids may be difficult to remove without significant effort.

After pumping COMMUNICATE with the Manure-Hauling Crew:

- Require to be contacted when pumping is done. Identify and discuss if there were any problems, biosecurity breaches, manure spills or need for any clean up after pumping and hauling.
- Consider providing a water source away from the facility or traffic patterns for the manure hauling crew to use to clean your manure from their equipment before leaving the farm.

PEDV infection at a sow farm can create near 100 percent mortality of piglets. Cleaning, disinfecting and drying all equipment is mandatory if moving to any negative site, especially to a sow site.

The biosecurity protection of your herd is your responsibility. Protect the health of your herd and communicate your biosecurity expectations with your manure hauler to avoid disease introductions.

Biosecure Manure Pumping Protocols for PEDV Control: Recommendations for Land Owners

Key Points

The introduction of the porcine epidemic diarrhea virus (PEDV) into the United States presents a challenge for manure pumping. **Infection with PEDV can create tremendous financial losses to a producer.** PEDV is transferred via feces and survives in manure and slurry for extended periods of time. Anything that becomes contaminated with pig manure can be a source of infection for pigs.

PEDV can survive in fresh feces for at least a week and between four and six months in slurry in deep pits. PEDV can survive in manure and slurry for longer time periods during cold weather. Virus survival also appears to be highly influenced by the manure pH. Fresh swine manure typically has a pH around 7.0. During storage, manure pH generally will increase to around 7.5 to 8.5. As manure pH approaches 8.0, virus survival seems to be adversely impacted. Testing of manure pH prior to pumping may provide some insight into the likelihood of active virus present in the manure.

Producers and Manure Haulers face some challenges in order to control the risks of spreading PEDV when pumping:

- The steps necessary to prevent PEDV from being moved from farm to farm during manure pumping and hauling take planning and may impact the timing of getting manure applied to fields.
- Increased time between sites may be required for washing and disinfecting equipment.
- It is highly recommended that sites known to be currently or previously positive for PEDV be managed last in the sequence of sites for a farm or system.
- Communicating with the manure haulers to find out when they plan initiate and complete manure pumping can help you plan other on-farm activities that may be impacted by pumping and transportation.

At the time of pumping and spreading manure:

- Farm personnel and your farm equipment need to avoid any direct contact with manure, manure-hauling personnel, or the manure-hauling equipment. Disease can be accidentally spread to other farms through manure contamination of people, vehicles and equipment.
- Adding lime to manure to raise the pH can inactivate PEDV. To ensure virus inactivation, approximately 50 lbs. of quick lime per 1,000 gallons of manure should be used to achieve a manure pH of at least 10. Lime should not be added directly to a storage pit, but may be added to a tank wagon used to haul manure to the application site. Raising manure pH can create significant odors from ammonia volatilization and can cause precipitation (settling) of solids from the manure. In a pit, these settled solids may be difficult to remove without significant effort.

PEDV infection at the sow farm can create near 100 percent mortality of piglets. Cleaning, disinfecting and drying all equipment is mandatory if moving to any negative site, especially to a sow site.

Biosecure Manure Pumping Protocols for PEDV Control: Recommendations for Commercial Manure Haulers

The introduction of the porcine epidemic diarrhea virus (PEDV) into the United States presents a challenge for manure pumping. **Infection with PEDV can create tremendous financial losses to the producer.** PEDV is transferred via feces and survives in manure and slurry for extended periods of time. Anything that becomes contaminated with pig manure can be a source of infection for pigs.

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Prior to the time of going to a site to pump **COMMUNICATE** with the producer/land owner:

- Ask about any changes in biosecurity protocol prior to going to the farm and before equipment set-up.
- Notify the producer/land owner when you are going to be at the farm.
- Share contact information between the manure-pumping crew and farm personnel.
- Be prepared to share the history of sites where your pumping crew has been.
- Work with the producer/land owner to identify appropriate site entry and exit to the site with minimal cross-over with other farm traffic or areas used by farm personnel. Ask what routes can and should be used to transport manure to fields.
- Ask where the “Line of Separation” is between the set-up, hauling equipment and farm site. This defines the area that is to be used by the manure haulers and the area to be used by daily farm traffic and personnel. Don’t cross over the line.
- Discuss how any manure spills will be handled.
- Inform all your employees of the biosecurity requirements discussed with the producer.

...continued on page 2

Biosecurity procedures recommended for all manure-pumping personnel:

- Manure haulers should not enter the barns, office areas or walk over areas used by farm personnel and should never come in direct contact with the pigs.
- Avoid any direct contact with farm personnel and do not allow pumping equipment access by farm personnel.
- Use clean coveralls, boots and gloves at each site.
- If personnel must CROSS-OVER the line of separation they must do the following:
 - » Cover-up with protective gear (boots, coveralls, gloves).
 - » Dispose of or properly contain any contaminated clothing in plastic bags / totes.
 - » Clean and disinfect any reusable gear for the next site.

After pumping COMMUNICATE with the producer:

- Inform farm contact person when pumping is done.
- Identify and discuss with producer if there were any problems, biosecurity breaches or manure spills.
- If possible, clean, disinfect, and dry equipment on-site away from traffic before traveling to the next farm site.
- Avoid bringing disease with you by changing outer clothing and boots between farms.
- Clean the cab of trucks, tractors and contaminated equipment before going to next site.

PEDV infection at the sow farm can create near 100 percent mortality of piglets. Cleaning, disinfecting and drying all equipment is mandatory if moving to any negative site, especially a sow site.

Leave the risks behind! Protect yourself and assume responsibility for the biosecurity of your manure-hauling equipment and hauling crew.

The Role of PEDV in Feed: Current Knowledge and Understanding

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Reviewers: Scott Dee, Joel DeRouchey, Steve Dritz, Phillip Gauger, Laura Greiner, Anne Huss, Eric Nelson, Mike Tokach, Henry Turlington, Pedro Urriola, and Jason Woodworth

Porcine epidemic diarrhea virus (PEDV) is a coronavirus that has affected the United States swine industry since 2013¹. Notably, the disease is not zoonotic and has no implication on human food safety, but its effect on pig welfare and productivity is detrimental¹. The virus affects pigs of all life stages, but the greatest mortality rates are observed in the farrowing house because the coronavirus targets mature enterocytes and leads to malabsorption, diarrhea, vomiting, and potentially lethal dehydration^{1,2}. It is estimated that the “year of PEDV” resulted in a 3.2 percent reduction in the U.S. swine herd in 2014 compared to the previous year³.

PEDV Transmission by Feed

The main route of PEDV transmission is fecal-oral, although airborne transport has also been implicated.^{1,4} Speculation was made that fecal contamination in feed and ingredients resulted in their role as a potential vector for transmission. Indeed, epidemiological and controlled research in 2014 confirmed that animal feed and ingredients can be a potential vector for PEDV transmission.⁵⁻⁷ Contaminated feed ingredients may have been responsible for rapid transmission of the virus, but research has not conclusively identified the primary route for PEDV into the U.S. A recent investigation report from the USDA suggested that flexible intermediate bulk containers, polyethylene tote bags, had the greatest likelihood to have been the source of PEDV entry into the country.⁸ These containers are widely used to transport feed ingredients. A follow-up study has since demonstrated that contaminated feed ingredients themselves may also serve as transboundary risk factors for PEDV.⁹ Research is needed to evaluate the likelihood of ingredients and transport vessels to retain PEDV and other foreign animal diseases, and to determine potential options for their decontamination.

PEDV Analysis

Analysis of PEDV in feed or ingredients can be conducted by using real-time, quick PCR (RT-qPCR) tests, through cell culture or via bioassay. The RT-qPCR analytical method reports the quantity of genetic material present in a sample. Its advantages include high sensitivity, low cost, and fast throughput. However, the analysis is not indicative of infectivity, and quantitative results are not always comparable among laboratories. On the other hand, both cell culture and bioassay have the ability to confirm infectivity. The determination of PEDV infectivity by cell culture is still ongoing and requires further refinement, and bioassay has inherently low sensitivity for detecting PEDV.¹⁰ Most of the PEDV research using bioassays has been conducted with just three pigs per treatment. In this model, a positive bioassay result is determined PEDV-positive, but a negative bioassay result does not necessarily indicate non-infectivity. Thus, bioassay is a poor estimator of the risk of disease transmission between farms of larger populations.¹⁰ Both bioassay and cell culture infectivity analyses are expensive and time consuming, so producers and feed mills can only practically utilize results from RT-qPCR analysis to make decisions to accept or reject ingredients. More research is needed to develop rapid detection methods for PEDV infectivity.

Infectivity of PEDV in Feed

One concerning aspect of feed being a vector for PEDV transmission is that very low doses can result in infectivity. The minimum infectious dose of PEDV contamination in feed for a pig to become infected has been reported to be seven infectious units or 5.6×10^1 TCID₅₀/g, which equates to a cycle threshold of 37 according to RT-qPCR.¹¹⁻¹³ **Ultimately, this means that just one gram of PEDV-infected feces contains enough viral particles to contaminate up to 500 tons of feed.**¹² The large magnitude of infectious PEDV generated, coupled with a low infectious dose, indicate that both prevention and proactive mitigation protocols are appropriate to reduce the risk of PEDV transmission through feed¹⁴.

Prevention of PEDV Entry

Likelihood of Entry Location in Feed Mills

Because PEDV can be transmitted by feed, the first goal is to prevent viral entry into a feed mill altogether. To better understand locations in a feed mill that may be considered at high risk for PEDV entry, environmental swabs were collected at multiple locations within 24 different feed mills that were manufacturing swine diets. The locations with the greatest number of PEDV positive swabs were the foot pedals from finished feed trucks and the bulk ingredient receiving pit.¹⁵ Notably, these samples were collected during the summer, which is considered a lower risk of infection season. While the percentage of PEDV-positive samples was low, the presence of the virus in the facility indicates that the feed mill itself may be a location of PEDV transmission.

Biosecurity Helps Control the Risk of PEDV Entry

To reduce the likelihood of contamination in the first place, many feed mills have implemented biosecurity plans and protocols to more closely control biological hazards, such as PEDV.¹⁶ Videos demonstrating biosecurity and sampling protocols have been created by Kansas State University, and are posted on their PEDV Resources page.¹⁷ Furthermore, an example biosecurity guidance document has been outlined by the American Feed Industry Association and is available for download in their Resource Center.¹⁸ Included in this document is guidance preventing the entry of hazards by inbound ingredients, vehicles and people. For example, some facilities have chosen to develop an Approved Supplier Program or a Test-and-Hold Program to reduce the risk of PEDV entry from potentially contaminated high risk ingredients.

Role of Ingredients on PEDV Stability over Time

Research indicates that PEDV survivability over time differs within the feed matrix. For example, the amount of PEDV nucleic acid detected by RT-qPCR in porcine meat and bone meal and spray-dried animal plasma have been reported to be relatively consistent over time, while the quantity of particles in many other feed ingredients and complete feeds are reduced over the same time period (Figure 1).^{19,20} Other research has indicated that spray-dried animal plasma is not particularly susceptible to retaining viral particles, but supported the finding that particular ingredients retained PEDV for an extended period of time.^{9,21} This was particularly true for soybean meal, which retained PEDV contamination for 180 days post-inoculation.^{9,21} It is suspected that protein composition or water activity play a role in PEDV survivability. For example, it has been reported that wet feed retains detectable PEDV RNA for up to 28 days, while the viral particles in dry feed are undetectable after seven days.²² Storage of ingredients also appears to effect the stability of the virus. Spray-dried bovine plasma retained PEDV viral particles for seven days when held at 72°F, 14 days when stored at 54°F, and 21 days when stored at 39°F.²¹ Research is needed to better identify the physical and chemical characteristics of ingredients that increase their risk for PEDV stability.

Impact of Ingredient Manufacturing Method on Viral Stability

Feed ingredients derived from porcine origin, or from locations where those ingredients are manufactured, may pose a greater risk for PEDV contamination due to an increased opportunity for post-processing cross-contamination. However, this contamination should be negligible if appropriate manufacturing controls are followed. In order to better understand the appropriate concern for PEDV contamination in different feed ingredients, a risk assessment was conducted to evaluate the risk of ingredients manufactured according to common practices, including rendering, hydrolysis and spray drying.²³ Rendering and hydrolysis both use high temperatures for a prolonged

period of time, which resulted in their categorization as having negligible risk to transmit PEDV when processes are carried out according to standard procedures.²³ Products manufactured by spray drying were determined to have a low risk of PEDV survival.²³ Compared to rendering and hydrolysis, spray drying utilizes a much shorter time × temperature combination, which may be responsible for its characterization as being slightly higher risk to result in PEDV contamination. Like all point-in-time mitigation steps, extreme care must be taken to prevent post-processing cross-contamination. This may be particularly concerning at ingredient manufacturing facilities where raw material with a high likelihood of infectivity and large number of viral particles may be present.

Not All PEDV-Positive Ingredients and Feeds Are Infectious

Some manufacturing processes denature viruses so they no longer have functionality to cause infection, but viral residues are still detectable by RT-qPCR. Spray drying may be one of those processes, because research has indicated that the process is sufficient to inactivate infectious particles.²³⁻²⁵ Indeed, PEDV RNA present in commercial spray-dried porcine plasma has been reported to non-infectious when manufactured according to best practices with appropriate controls to prevent cross-contamination.²⁴⁻²⁶ Unfortunately, the advancement of some research is limited because the determination of infectivity must ultimately be conducted by cell culture or pig bioassay.

Summary of Key Points

- Surveys indicate foot pedals of trucks and the ingredient receiving pit are potential locations for PEDV entry into feed mills.
- Biosecurity procedures, including the control of people, vehicles, and inbound ingredients may help reduce the risk of PEDV transmission
- Stability of PEDV varies in different ingredients.
- The rendering and hydrolysis processes result in negligible PEDV survival as long as they are completed according to protocol. However, post-processing cross-contamination must be controlled to minimize the ingredients as potential routes for infection.
- The spray-drying process results in a low risk of PEDV survival. This dose of contamination in raw material and potential for post-processing cross-contamination potential are critical factors in transmission risk.

Options for Proactive Mitigation

Strategies for Point-in-Time Mitigation

Irradiation: Once contaminated, it is possible for the quantity of infectious PEDV particles to be reduced. Both irradiation and thermal processing have been demonstrated to successfully reduce the quantity of PEDV RNA. Irradiation with 50 kGy has been reported to inactivate 99.97% of the virus, while irradiation with 10 kGy inactivated 90% of the virus.¹¹ While this is a substantial reduction, the process still likely leaves a sufficient number of particles for infection depending upon the initial contamination level. Furthermore, the dose of irradiation required for this reduction is relatively high compared to other foods. For example, 3 and 4.5 kGy recognized by FDA as sufficient doses for pathogen control in cooked eggs and refrigerated uncooked meat, respectively.²⁷ The magnitude of irradiation required for efficacy to reduce PEDV is greater than the available capabilities in the U.S. today. While irradiation may be a successful and possible treatment for specific high risk ingredients, it is not practical for large-scale feed production.

Thermal Processing: A more plausible manner to reduce the quantity of detectable PEDV RNA is through thermal processing. Research has found that 99.99% of PEDV is inactivated by heating at 194°F and 70% relative humidity for 10 minutes.¹¹ Again, the time × temperature required to inactivate the virus was matrix dependent, as the same parameters required 15 minutes for similar inactivation in spray-dried animal plasma.¹¹ The most practical method of thermal processing in the U.S. swine industry is by using a steam conditioner and pellet mill. Research suggests that pelleting feeds with a conditioning temperature greater than 130°F for 30 seconds reduces PEDV infectivity.^{28, 29} Traditional conditioning temperatures in the U.S. are well above this temperature, so pelleting can be a means to reduce the risk of PEDV transmission in feed. However, there may be opportunities for infectious feed to be produced, even when pelleting at these parameters. Because feed mills rarely have rework bins, any feed manufactured during start-up or in the case of a die plug may not reach the required time × temperature combination for PEDV inactivation, and this feed could potentially cause downstream cross-contamination to equipment or otherwise PEDV-free feed.

Strategies to Reduce the Likelihood of Cross-Contamination

Flushing and Sequencing Procedures: If PEDV enters a feed mill, steps must be taken to prevent cross-contamination to other ingredients, feed, and equipment. An experiment conducted in a pilot-scale feed mill demonstrated that over 85% of all swabbed surfaces were positive for PEDV after a PEDV-positive feed was mixed and conveyed through a bucket elevator (Figure 2).^{28, 30} Flushing helped to reduce the quantity of detectable RNA in feed samples collected from the mixer, but feed samples collected from the bucket elevator remained PEDV-positive through four subsequent flushes.^{28, 30} While the proportion of PEDV-positive swabs collected from feed contact surfaces was reduced from 100 to 85 percent with flushing, the adjacent and structural surfaces remained highly contaminated throughout manufacturing.^{28, 31} Furthermore, wet cleaning with both a commercial sanitizer and bleach solution was required to completely decontaminate the facility, a practice that is not practical for a feed mill.^{28, 32} The quantity of detectable PEDV RNA and its infectivity in a bioassay suggest that residual feed in manufacturing equipment and ubiquitous contaminated dust may provide a means for cross-contamination within a feed mill. Therefore, sequencing can be used to help reduce the likelihood of PEDV contamination after manufacturing high-risk feeds, but care should be taken to control dust and its addition back into feed.

Chemical Additives: The previously outlined strategies can be successful at a point-in-time, but provide the opportunity for post-processing cross-contamination. Chemical additives may be utilized by a facility to reduce the probability of this cross-contamination throughout the feed production chain because they provide some level of residual activity that decreases the likelihood, magnitude, and duration of PEDV cross-contamination during manufacturing, transport or storage. To test their ability to resist cross-contamination, feeds or ingredients were first treated with the chemicals, then inoculated with PEDV and analyzed for virus presence or infectivity over time. The commercially-available products tested for PEDV include SalCURB (Kemin AgriFoods), Termin-8 (Anitox), sodium bisulfate (Jones-Hamilton, Co.), salt, sugar, KEMGEST (Kemin AgriFoods), ACTIVATE DA (Novus International), Acid Booster (Agri-Nutrition) and Ultracid P (Nutriad). Notably, none of these products are labeled for PEDV mitigation. Other products tested that are not commercially available include custom blends of each medium chain fatty acids (MCFA), essential oils and organic acids.

The formaldehyde-based SalCURB and Termin-8 consistently reduced the quantity of detectable PEDV RNA in feed and ingredients, and have been demonstrated to prevent infectivity.^{9, 19-21, 33- 36} Furthermore, salt, sugar, and KEMGEST have resulted in faster PEDV inactivation compared to a control, but none of these additives completely inactivated the virus¹¹. The inclusion of a custom blend of 1 or 2 percent MCFA (equal parts capric acid, caprylic acid and caproic acid) and 2 percent essential oil (equal parts garlic oleoresin, turmeric oleoresin, capsicum oleoresin, rosemary extract, and wild oregano essential oils) have also demonstrated the ability to reduce PEDV RNA concentrations and the MCFA blend has prevented infectivity.^{9, 19, 20, 33, 35, 36}

Again, the efficacy of chemical additives to reduce the likelihood, magnitude, or duration of contamination appears to be affected by the feed matrix. For example, the formaldehyde-based products and MCFA may be more effective

at reducing the magnitude and duration of PEDV contamination in ingredients than a complete diet as detected by RT-qPCR.^{19,20} Still, the chemical treatments resulted in non-infectivity in both matrices.³³ While potentially effective at helping prevent post-processing cross-contamination, chemical additives carry additional cost, often require specialized application equipment for maximum effectiveness, and may create worker safety concerns due to hazardous components of the chemicals.

Summary of Key Points

- Irradiation can effectively inactivate PEDV, but the required dose is high and more relevant for targeted ingredients than for complete feed.
- The interaction of time × temperature can be used to reduce PEDV infectivity, but the required combinations are dependent upon the feed and ingredient composition.
- Pelleting feed with a 130°F conditioning time for 30 seconds reduces PEDV infectivity, but it is rare for all feed during an entire run to reach these parameters.
- Both irradiation and thermal processing are point-in-time kill steps that do not prevent potential downstream cross-contamination.
- Once PEDV enters a feed mill, it can spread ubiquitously and be difficult to decontaminate.
- Flushing or sequencing can help reduce the likelihood of infectious contamination in feed exiting the mixer, but does not reduce the magnitude of contaminated manufacturing surfaces.
- Chemical additives may help reduce the likelihood, magnitude, or duration of PEDV cross-contamination in feed or ingredients, with formaldehyde-containing commercial additives and medium chain fatty acids showing the greatest efficacy.

Conclusion

Feed has been demonstrated to be one of many potential vectors for PEDV transmission, and a very low dose of the PEDV can result in clinical disease. Substantial research has been conducted in the past two years regarding the role of PEDV in feed. If proper biosecurity and manufacturing procedures are followed, there is a low likelihood of PEDV contamination in finished feed. However, the sheer magnitude of PEDV infectivity creates the argument for utilizing multiple methods to further reduce risk. Continued research is needed to further understand the role of PEDV in different feed matrices and to develop better feed-based analytical methods to assess infectivity. While we have learned a great deal about viral pathogen transmission in feed, more research is needed to eliminate its role in the spread of PEDV and other potential feedborne foreign animal diseases.

Future Work

- Improve biosecurity to prevent biological hazards in feed mills.
- Develop accurate feed-based rapid-detection technologies for PEDV infectivity.
- Understand the role of the feed matrix on stability of PEDV and efficacy of chemicals to prevent cross-contamination.
- Develop and test practical inclusion levels of chemical additives.
- Determine applicable sanitation procedures for contaminated feed manufacturing surfaces.
- Evaluate methods to prevent downstream cross-contamination of PEDV throughout the feed system.

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Figure 1.

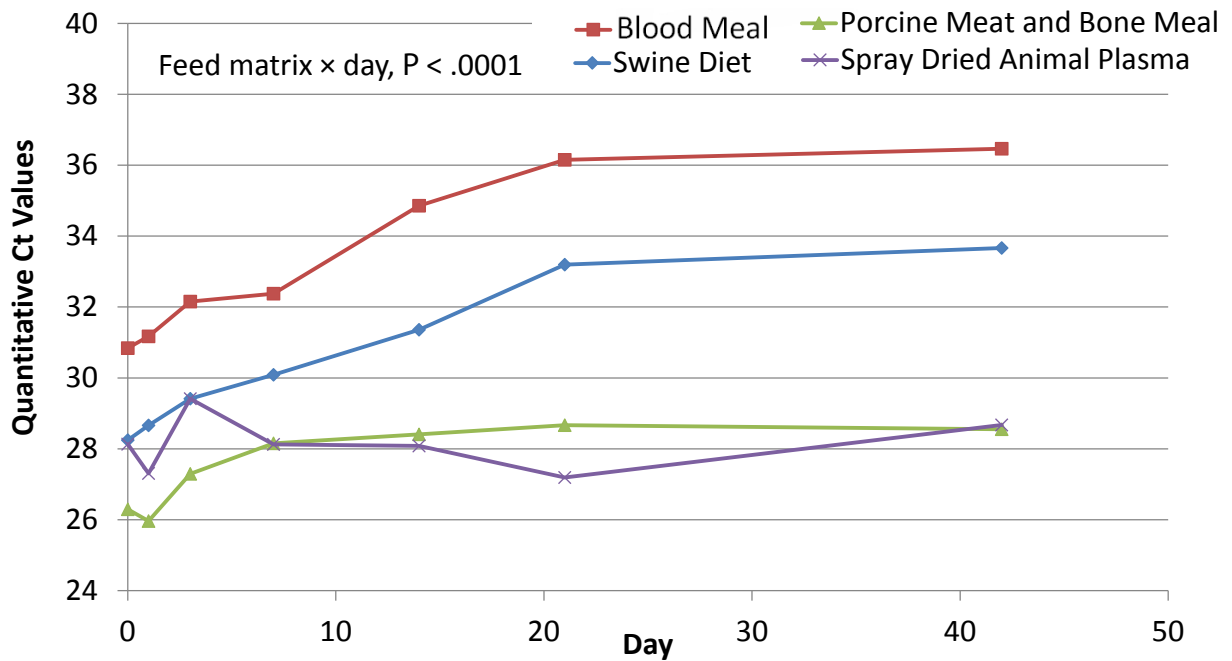
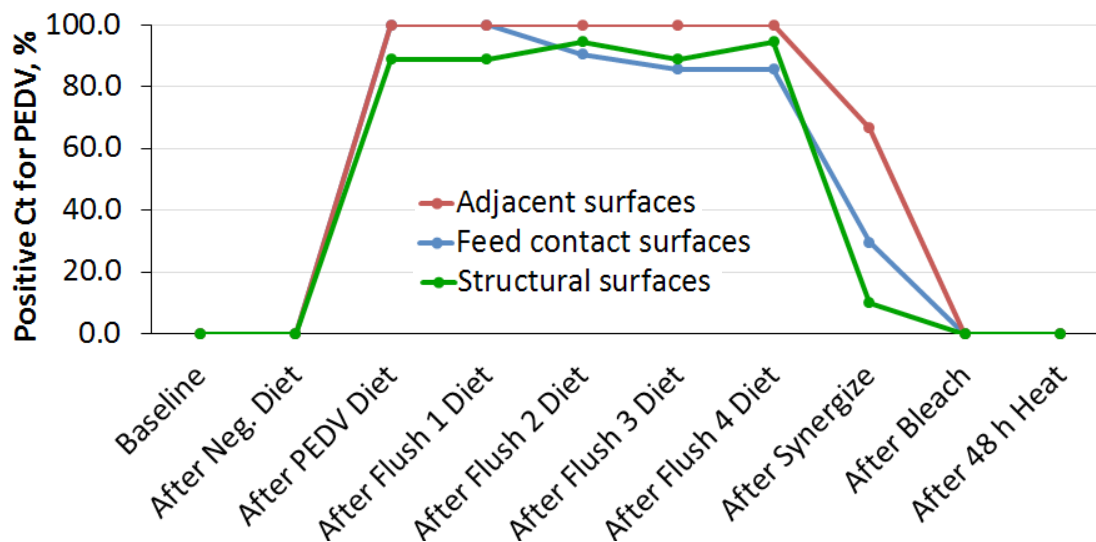


Figure 2.

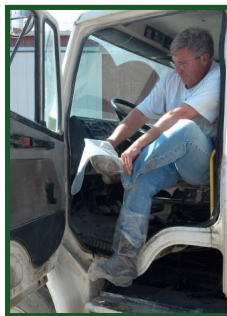


Feed Delivery Biosecurity for Control of Disease

The recent introduction of the porcine epidemic diarrhea virus (PEDV) into the United States presents a challenge for the industry. PEDV transfers via feces and survives effectively in manure at various temperatures and humidity levels. PEDV can survive in feed for extended periods of time in individual feed ingredients, complete feed and within feed systems.

Contamination of feed, trucks, equipment, and clothing or footwear with infected feces can spread the virus. Infection with PEDV can create tremendous financial losses to the producer. It is important that everyone do their part to prevent spread of this disease.

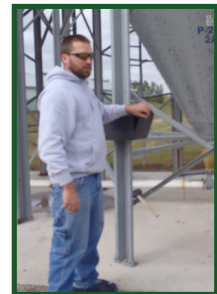
1. Transport drivers arrive at work wearing clean clothes and footwear which hasn't been worn around livestock.
2. Carry cover-ups (clean, disinfected rubber boots or disposable boots) in a clean container in the truck cab. Before exiting the transport truck, put on the cover-ups.
3. Stay as close to the truck as possible to minimize the areas you come in contact with.
4. Stay near the truck in order to maintain the Line of Separation and allow for space between you or your equipment and the production facilities. Whenever possible, communicate with the farm staff and ask them to open and close the bin lids.



5. Remove cover-ups when climbing back into the truck and contain and dispose of garbage in a separate bag or plastic container.



6. Apply hand sanitizer to maintain a clean cab before touching surfaces.
7. Do not cross the Line of Separation that is between the production facilities and you or your equipment. This includes not entering the barn office or facilities. Invoices should be left in a designated area, such as mailboxes attached to the bin leg or outside of the office.
8. Bagged feed is dropped in a designated area, without crossing the Line of Separation that is between you and the production facilities.



Swine Health Recommendations: Biosecurity for Organizers of Weigh-in or Tagging Events

Animals that are commingled at an exhibition, sale or another event pose a risk for spreading disease. Organizers and advisors scheduling commingled pig events should assess each situation and the associated risks to pig health. The recommendations listed may be applied to all swine commingling events at centralized locations and to other pigs that are physically on the premises. Before your event, have a plan in place to manage pigs from many different locations and to handle sick pigs properly. This planning will help reduce the chance of disease spread.

Basic Biosecurity: At the Weigh-in

1. Owners should be the only persons going into a trailer to sort or restrain pigs.
2. At the time of the weigh-in, owners and advisors should wear clean clothes and footwear which can be cleaned (or disposable coveralls over clothing and plastic boots over one's shoes).
3. Have a garbage bag for disposing used plastic boots. Carry another for clothes that may be dirty. Dispose of disposable coverings before leaving weigh-in site.
4. Keep the health papers in a zip-lock bag (just in case you drop them on the ground).
5. Limit the exposure of your pigs to the facility and equipment as much as possible.
6. If an animal is suspect to be ill at the time of handling, manage that animal last.

Basic Biosecurity: At the Weigh Scale

1. When using a stationary scale (one that does not move from site to site):
 - Have owners move pigs to the scale, but not enter the scale themselves.
 - Sweep the scale free of manure and shavings between pigs and when finished. Remove manure from scale area between different groups of pigs

- Move manure and shavings to a separate location away from pig/exhibitor traffic to avoid potential spread of pathogens.
 - Thoroughly wash and disinfect the scale and area around it at the end of weigh-in. Allow to dry before re-use.
2. When using mobile scale (a scale that goes to more than one location):
 - Prior to use, make sure that the scale is fully clean and free of dirt/manure. Disinfect and allow to dry.
 - Have owners move pigs to the scale, but not enter the scale themselves.
 - Sweep the scale free of manure and shavings between pigs and when finished. Remove manure from scale area between different groups of pigs.
 - Thoroughly wash and disinfect the scale and area around it at the end of weigh-in. Allow to dry before sending to another location.
 - The vehicle that moves the scale should also be cleaned and dried before going to another location. The interior of the vehicle should be free of any dirt and debris.

Clean and dry equipment will help to reduce the spread of pathogens.

- Contain any garbage that may accumulate at one site and dispose of before going to another location.

Basic Biosecurity: Tagging Animals

1. Owners should be the only persons to enter a trailer and restrain the pig(s).
2. If tagging can be done at the back of the trailer:
 - Owners should sort pigs to the back gate and restrain the pigs.
 - Staff assisting in ear tagging should not enter the trailer.
3. Start with clean and disinfected taggers and have multiple taggers available that are clean and ready to use.
4. Disinfect/wipe down taggers between each pig (Examples: utilize bleach wipes or have pre-mixed disinfectant available for use).

Basic Biosecurity: Vaccinating Pigs

1. Owners should be the only persons to enter a trailer and restrain the pig(s).
2. If vaccination can be done at the back of the trailer:
 - Owners should sort pigs to the back gate and restrain the pigs.
 - Staff assisting in vaccination should not enter the trailer.

3. Start with clean and disinfected syringes and needles. Have additional equipment available for use that are clean and ready to use.
4. Wipe down the exterior of the syringe in between each pig (Example: use bleach wipes).
5. Use a new needle for each pig.
6. If using a multi-dose syringe:
 - Use a new needle each time a new dose or amount of vaccine is taken from the bottle.
 - Use a new needle per pig.
7. Keep proper records for each pig of vaccine given including the date, dose, product name, vaccine serial number and withdrawal time.



Pigs with official 840 AIN tags.

Biosecurity recommendations for exhibitors are available at pork.org.

Swine Health Recommendations: Organizers of Exhibitions and Sales

With the animals being commingled at an exhibition, show or sale, spreading disease is a risk. The recommendations listed apply to all swine at an exhibit or sale that are physically on the premises. Having a plan in place to identify and handle sick animals properly will help reduce the chance of disease spread.

Prior to the exhibition:

Identify a veterinarian being available for activities to assist the organizers with the exhibit, including:

- Animal check-in
- Daily health evaluation during the show or exhibit
- Sample collection and submission
- Determining actions for sick pigs including: removal from the exhibit, isolation and/or treatment

Post the veterinarian's contact number at the exhibit office and within the barn.

Write-up and discuss a plan to address potential animal health issues with the veterinarian and exhibit staff in order to coordinate all efforts including sample collection if needed.

Ensure that all exhibition staff assisting with the event become familiar with the clinical signs of a sick pig (such as fever, off-feed, lethargy, nasal discharge, cough, and diarrhea) and will relay that information to the veterinarian or primary organizer contact.

- Understand the risks to both humans and animals of having a sick pig at an exhibition.
- Locate an isolation area away from the main exhibit to be used in the event sick pigs are identified:
 - » An off-site location is preferable

- » If not possible, use an area blocked off from public and animal traffic
- » Use staff personnel who do not have any contact with other pigs on the fairgrounds

Other animals, such as dogs and cats, can physically transfer pathogens. To prevent spread of diseases, request that pets be kept home and not brought to the exhibit.

At the exhibit:

At check-in, each pig should be evaluated and any sick pigs should not be unloaded. Options can include:

- Send the pig(s) home immediately
- Using isolation

Check-in recommendations to prevent potential disease spread:

- Exhibit officials should avoid entry into the trailers; owners should provide health certificate for exhibit staff to review outside of the trailer.
- If exhibit officials have to enter a trailer to examine an animal, use disposable coveralls and boots and dispose of after single use.
- Use a hand-washing station between loads or have hand sanitizers or wipes available.

All animals should have an accompanying health certificate signed by an accredited veterinarian.

- Include premises identification number (Required for PQA Plus® certification or other state equivalent).
- Record the official ID for each pig taken to the exhibition on the health certificate.
- Refer to the state veterinarian's office for specific animal identification requirements.
- Remember that health certificates are valid for 30 days.

Observe swine daily for signs of illness, which may include fever, lethargy, lack of an appetite, nasal discharge, cough or diarrhea.

Report any illness to the primary veterinarian or the appropriate exhibition staff (i.e. swine superintendent) so the pig can be evaluated.

Swine deemed to be ill should be removed from the exhibition immediately.

Use precautions when caring for sick pigs to minimize the opportunity for disease transmission to other pigs or people:

- Do not restock the sick pigs' pen with other animals.
- Halt or limit foot traffic around the pen.
- Scoop or sweep manure back into the pen and then carry the shovel or broom to isolation.
- Wash hands after handling sick pigs and change clothing and boots.



Recommendations for Isolation:

- The isolation area is an area away from general exhibit traffic and other animals. It can be a small room or an area of the barn where no other animals are housed.
- Only the individuals who care for the pig and the attending veterinarian should enter the area.
- Disposable coveralls and plastic boots should be worn when entering the area and removed and thrown away when leaving.
- A hand-wash station or hand sanitizer should be available at the entrance of the isolation.
- A trash can should be placed in a convenient location for use in isolation only.
- Supplies such as buckets and feed pans should not be shared between pigs in isolation and other animals.
- All equipment should be thoroughly cleaned, disinfected and allowed to dry after use in isolation.

Swine Health Recommendations: Exhibitors of All Pigs Going to Exhibits or Sales

With the animals being commingled at an exhibition, show or sale, spreading disease is a risk. The recommendations listed apply to all swine at an exhibit or sale that are physically on the premises. Having a plan in place to identify and handle sick animals properly will help reduce the chance of disease spread.

In preparation for the exhibit or sale:

Consult a veterinarian to understand and implement applicable biosecurity and swine health practices; keep the veterinarian's phone number in your barn with your pig's papers and if possible, in your cell phone.

Have a premises identification number for your farm or where the pig(s) are housed (required for PQA Plus® certification or state equivalent)

Use an individual, readable identification method for each pig:

- Individual identification helps accurately and quickly identify a pig in the event of a health issue, validation of ownership or for other exhibit needs; papers can get lost or misplaced, but individual identification will remain with the pig.
- Refer to the exhibit organizers and the state veterinarian for specific requirements for individual animal identification .

Know the clinical signs of a sick pig (such as fever, off-feed, lethargy, nasal discharge, cough, “thumping” or hard time breathing, and diarrhea).

- Normal rectal temperature of a pig = 101.5-102.5° F.
- Pigs can't sweat. They need help staying cool on hot days.
 - » During hot weather a pig's temperature may be elevated.
 - » If its temperature is raised, allow the pig to cool off and retake the temperature in 15 minutes.
- Work with your veterinarian if your pig becomes sick.

How do I take my pig's temperature?

1. Restrain your pig to avoid injury to you or the pig
2. Use a thermometer to measure temperature:
 - a. *Digital*: insert into the rectum; push the button and wait for the beep; read temperature
 - b. *Mercury*: shake down the thermometer so the red line is not showing; insert into the rectum of the pig and wait 30 seconds before reading the temperature
 - c. *Laser*: point the laser at the space on the skin behind the ear and read temperature

NOTE: Laser thermometer may not be as accurate as rectal thermometer



Digital Thermometer

Some diseases can transmit from humans to pigs and from pigs to humans, so it is important to not go to the exhibition or show if you or your pig is sick.

Make sure that you have all of your equipment, including your show box and its contents, clean, disinfected and ready to go prior to the exhibition. Do not share any equipment with other exhibitors once at the exhibit.

Fill out the appropriate paperwork for the exhibition including health certificates.

For your pig's health certificate, you will need to provide the following information:

- Your name, contact information and farm address.
- Include your premise identification number (PIN) on the pig's health certificate.
- Record animal movements even if a health certificate is not required. This information can assist in the event of a health challenge.
- Individual pig identification and physical description for each animal going to the exhibit or sale.
- If exhibiting in a state other than where you live, have your veterinarian check with the state you are exhibiting in for specific requirements.
- Include information for exhibit-specific requirements
- If requested, list any current vaccines the pig has received (i.e. influenza or PRRS) and current disease testing (i.e. PRRS; PRV).

Animals like cats and dogs can carry pathogens that can make pigs sick. It is important to prevent the spread of pathogens to your pigs or to others. Keep pets at home, do not let them be in contact with your pigs and do not bring them to the exhibit.

At the exhibition or sale:

- Assess your pigs' health on a daily basis.
- Report any swine health issues to the exhibit organizer (i.e. swine superintendent) or show veterinarian so they can assess the pig in question.
- Ask the exhibition organizer about any specific actions that may be required if a pig becomes sick at the show.
- Keep your area clean and free of manure contamination.
- Do not share equipment with other exhibitors.
- Do not bring your pets (cats or dogs) to the exhibit.

Once you get home:

When pigs from different farms are brought to an exhibit or sale and commingled with other pigs of a different health status, the risk of catching a disease can be high.

Just like people can spread illness to each other when gathered in a group, pigs from many locations in an exhibit can also spread illness to each other. Therefore, when you bring your pig back home from an exhibit or sale, it is best to place them in isolation.

Isolate returning pigs from the other pigs at your farm.

- Work with your veterinarian for an isolation plan. The isolation/observation period before returning to contact with other pigs should be no fewer than 7-30 days in order to detect an illness.
- Consult a veterinarian if your pig becomes ill.
- Clean and disinfect equipment, clothing, shoes, show box and contents, and vehicles/trailers that were used at the exhibition.

Clean-up can be as simple as washing, disinfecting and allowing your equipment to dry out in the sun.

Clean and dry equipment will help to prevent the spread of pathogens.

Recommendations for isolation: (if you have other pigs at your farm)

- Isolation will allow time for pigs to be observed for disease after they return from an exhibition or sale. When pigs are in isolation, additional testing can be complete to check for diseases before pigs are added back to the rest of the farm (e.g. PRRS). Check with your veterinarian for testing recommendations.
- Have a designated area away from other pigs that have not been to an exhibit.
- Do chores for the isolation pigs as the last task of the day after you have already worked with your other pigs.
- Have dedicated boots and coveralls for isolation only. Another option is to use disposable coveralls and plastic boots for use in isolation and then thrown away when done in isolation.
- Have a separate trash can for use in isolation only.
- Supplies such as buckets and feed pans should not be shared between pigs in isolation and other animals.
- All equipment should be thoroughly cleaned, disinfected and allowed to dry after use in the isolation area.



**For the latest Checkoff-funded PEDV information
and resources, go to pork.org/pedv**



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